

## **REMARKS**

### **Co-pending Application**

Co-pending with the present application is U.S. Application Serial No. 11/706,044, which is directed to subject matter related to the present application.

### **Status of the Claims**

Claims 1, 3-5, 8-9, 11-15, 36-38 and 40-49 are currently pending in the present application. Claims 39 and 48 have been canceled.

### **Amendments**

Independent Claims 1 and 46 have been amended to state that the substrate is contacted by the purified purge gas at a temperature of about 20 °C to 100 °C. This amendment is supported by the specification as originally filed, for example, at page 11, lines 18-35 and by the originally filed provisional application at page 14. Claims 1 and 46 have also been amended to clarify that the oxygen referred therein has the chemical formula "O<sub>2</sub>." This amendment is supported by the specification, for example, in Figs. 19-21.

Claim 5 has been amended to clarify that the concentrations specified refer to AMC in the purified purge gas. This amendment is supported by the specification, for example, at page 10, lines 6-12.

Claim 15 has been amended to delete argon from the Markush group, since argon is already included generically as a noble gas.

Claims 41 and 49 have been amended to specify that the oxygen of the purified purge gas is provided as a component in extra clean dry air. This amendment is supported by the specification, for example, at page 16, lines 8-10.

Claims 50-52 are new. Claim 50 specifies that the inert gas of claim 15 is argon and is supported, for example, at page 10, line 32. Claim 51 is an independent claim that recites a method for removal of airborne molecular contaminants from a substrate using a purified humidified purge gas comprising extra clean dry air (XCDA). Claim 51 is supported by Claim 1 as originally filed and by Table 1 of the specification at page 20, which includes purge gases

comprising XCDA and water. Claim 52 recites a method for removal of airborne molecular contaminants from a substrate under conditions that do not chemically change or alter the AMC. Claim 52 is supported, for example, by Claim 1 as originally filed and by the specification at page 9, lines 1-12, which states that contamination is removed by a kinetic (as opposed to chemical) effect.

Rejection under 35 U.S.C. §112, second paragraph

Claims 5, 39, 41, and 48-49 were rejected under 35 U.S.C. § 112, second paragraph as being indefinite. The Examiner stated that it is unclear that whether the concentrations recited in Claim 5 refer to the concentration of the purified purge gas or the concentration of the AMC in the purified purge gas. As stated above, Claim 5 has been amended to clarify that the concentrations specified refer to AMC in the purified purge gas.

Rejections under 35 U.S.C. § 103

Claims 1, 3-5, 8-9, 11, 38-39, 41-43, 46 and 48-49 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,427,703 (hereinafter, "Somekh") in view of U.S. Patent No. 6,391,090 (hereinafter, "Alvarez").

Somekh discloses removing carbon deposits from equipment by reacting the carbon deposits to form a volatile gas species. (See Somekh col. 3, lines 13-45.) In particular Somekh discloses transforming the surface carbon deposits into an oxidized carbon gas, namely carbon monoxide (CO) and carbon dioxide (CO<sub>2</sub>) (col. 5, lines 34-41). The Somekh process requires that the oxidizer contain sufficient energy to permit the chemical transformation of the carbon deposits into volatile gas species. For example, Somekh discloses using high energy, such as thermal activation, microwave activation, plasma discharge, and ozone activation (col. 6, lines 38- 45) to chemically transform the carbon deposits into CO and CO<sub>2</sub> and subsequently removing the different gaseous entities (col. 5, lines 33-40).

With regard to the use of microwave activation, plasma discharge, and ozone activation, it is noted that Applicants claims do not use such methods. Rather, Applicants claims recite the steps of "contacting" and "transferring," and, as described further below, these steps occur by kinetic effect. Microwave activation, plasma discharge, and ozone activation are not necessary

in Applicant's claimed process, because high energies are not required to practice the recited steps.

With regard to thermal activation, Applicants note that high temperatures are required to effect the oxidation process described in Somekh, because the activation energy required for oxidation of carbon using oxygen or water is high. For example, NASA CR-1682, a portion of which is attached hereto as Exhibit A, indicates that hydrogen oxidation reactions that convert carbon into CO and CO<sub>2</sub> occur in the range of 1000-1400 °F (538-760 °C). Also, the Kiev University publication entitled "Low-temperature Carbon Oxidation in a Gradient-Free Reactor," also attached hereto as Exhibit B, states that carbon oxidation using molecular oxygen (O<sub>2</sub>) occurs at 693-923 °K (421-651 °C).

Thus, there is no teaching in Somekh, either express or implied, that the method taught therein is performed at a temperature of about 20 °C to 100 °C. Further, a person of ordinary skill in the art would not be motivated to use the method taught in Somekh at the presently claimed temperature range, because much higher temperature conditions are required for oxidation reactions to occur.

Further, Somekh does not teach "producing a contaminated purge gas by *transferring* AMC from the substrate into the purified purge gas" (emphasis added), as stated in Claims 1 and 46 of the present application. The term "transferring," as it is used in the present claims, does not equate to the word "remove" as that word is used by Somekh. Somekh "removes" carbon deposits by reacting them to form volatile gases. The present invention does not "remove" AMC by reacting them to form different chemical entities, the present invention involves "transferring," or moving, an AMC from a surface to a purge gas. For example, at page 9, lines 1-12 of the present specification, Applicants state that the contaminants diffuse into the purge gas and that contaminant species are desorbed by a kinetic effect. Neither of these descriptions indicates that the contaminants are "removed" via chemical reaction and a subsequent transport of the reaction products, as is disclosed by Somekh. Instead, both descriptions are consistent with the Applicants' intended meaning of the word "transferring."

Alvarez does not remedy the deficiencies of Somekh. Alvarez teaches a method for purification of lens gas employing a combination of three contaminant-absorbing materials that allow decontamination of the gas down to a sub-ppb level, preferably less than 100 ppt (col. 5,

lines 2-19). Alvarez does not teach or suggest contacting a portion of a substrate with purified purge gas comprising oxygen and water at a temperature of about 20 °C to 100 °C, as recited in Applicants' independent claims 1 and 46. Alvarez also does not teach producing a contaminated purge gas by transferring AMC from the substrate into the purified purge gas, as recited in Applicants' independent claims 1 and 46.

Because neither Somekh nor Alvarez, alone or in combination, teaches or suggests the claimed invention, the presently claimed invention is patentable over those references. Applicants request reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a) in view of Somekh and Alvarez.

Claims 14-15 and 40 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Somekh in view of Alvarez as applied above, and further in view of U.S. Patent No. 6,724,460 of Van Schaik ("Van Schaik").

Van Schaik discloses a method to clean optical components whereby a purge gas, which includes "an *oxygen-containing species* selected from water, nitrogen oxide and oxygen-containing hydrocarbons," is irradiated "to produce atomic oxygen or other oxygen-containing radicals, which are highly effective cleaning agents" (Van Schaik at col. 4, ll. 1-27; Emphasis added). Van Schaik discloses forming reactive radicals and chemically reacting those radicals with hydrocarbons to form different chemical entities. In particular, Van Schaik states "[f]rom experiments it is deduced that water predominantly dissociates at the surface of the reticle, thereby forming highly reactive OH-radicals. As these OH-radicals are located near to or on the hydrocarbon *contaminant* residing on said surface, it *reacts* readily therewith." (Van Schaik at col. 7, lines 49-54; Emphasis added).

Van Schaik does not teach or suggest contacting at least a portion of the substrate with a purified purge gas comprising oxygen (O<sub>2</sub>) at a temperature of about 20 °C to 100 °C, as described in the claims of the present invention. That is, (1) the "oxygen containing species" disclosed in Van Schaik do not constitute "oxygen" as this term is used in the present specification (i.e., molecular oxygen, also known as O<sub>2</sub>), and (2) the method of contaminant removal disclosed in Van Schaik does not occur under the recited temperature conditions. Therefore, claims 14, 15 and 40 are patentable over Somekh in view of Alvarez and Van Schaik. Reconsideration and withdrawal of this rejection are therefore respectfully requested.

Claims 1, 3-5, 8-9, 11, 14-15, 38-43, 46 and 48-49 were rejected under 35 U.S.C. § 103(a) as Van Schaik in view of Alvarez.

As described above, Applicants have amended Claims 1 and 46, which recite, in part, contacting at least a portion of the substrate with a purified purge gas at a temperature of about 20 °C to 100 °C. Since Van Schaik does not teach or suggest contacting at least a portion of the substrate with a purified purge gas at a temperature of about 20 °C to 100 °C, Van Schaik does not teach or suggest the subject matter of independent Claims 1 and 46 as amended.

Further, Alvarez does not remedy this deficiency of Van Schaik. Alvarez also does not teach or suggest contacting at least a portion of a substrate with a purified purge gas at a temperature of about 20 °C to 100 °C. Reconsideration and withdrawal of the rejection are therefore respectfully requested.

Claims 1, 3-5, 8-9, 11 and 38-49 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Application Publication No. 2005/0017198 of Van Der Net (“Van Der Net”) in view of Alvarez.

Van Der Net teaches a purge gas supply system for a lithographic projection apparatus. The purge gas can include compressed dry air and moisture. Specifically, the reference teaches that “a relative humidity above or equal to 20%... provides good results,” (paragraph [0056]).

Alvarez is directed to a method and composition for removing contaminants in a gas stream. Alvarez states that water is a contaminant commonly present in the lithography environment (col. 2, lines 55-62). The invention of Alvarez is used to remove contaminants such as neutral polar molecules, *e.g.*, water (col. 5, line 67 - col. 6, line 5). Alvarez states that water at 100 ppm is 4-5 orders of magnitude more concentrated than most non-atmospheric contaminants and therefore “the effective removal of water is of the utmost importance.” (col. 8, lines 1-4). The invention of Alvarez “very effectively” reduces water content in a gas stream down to the order of 1 ppb or lower (col. 7, lines 6-9).

In view of the above teachings of each of Van Der Net and Alvarez, a person of ordinary skill in the art would not have been motivated to combine the two references. Van Der Net teaches that adding moisture is needed for good results, while Alvarez states that it is important to effectively remove water. Reconsideration and withdrawal of this rejection are therefore respectfully requested.

Claims 14-15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Van Der Net in view of Alvarez as applied to claims 1, 3-5, 8-9, 11 and 38-49 and further in view of Van Schaik. Withdrawal of this rejection is requested for the same reasons with respect to claims 1, 3-5, 8-9, 11 and 38-49 above.

Double Patenting Rejection

The Examiner rejected claims 1, 38, 41, 46, and 49 on the ground of nonstatutory obviousness-type double patenting over claims 19-21 of U.S. Patent No. 7,377,982. Applicants will address this issue upon indication of allowable subject matter.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

HAMILTON, BROOK, SMITH & REYNOLDS, P.C.

By 

Alice O. Carroll

Registration No.: 33,542

Telephone: (978) 341-0036

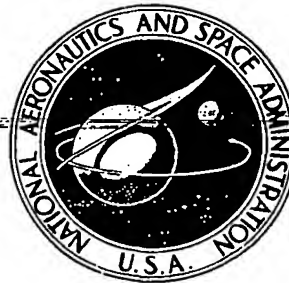
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**A CARBON DIOXIDE REDUCTION UNIT  
USING BOSCH REACTION AND  
EXPENDABLE CATALYST CARTRIDGES**

*by R. F. Holmes, E. E. Keller, and C. D. King*

*Prepared by*

CONVAIR DIVISION OF GENERAL DYNAMICS CORPORATION

San Diego, Calif. 92112

*for Langley Research Center*

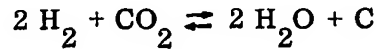
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**EXHIBIT**

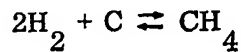
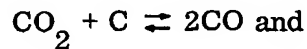
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#### 4.0 TECHNICAL DISCUSSION

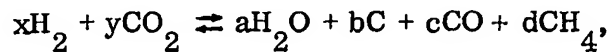
Figure 4.1 is a simplified diagram of the Bosch reaction for CO<sub>2</sub> reduction. The Bosch catalytic reactions occur at temperatures in the range of 1000 to 1400°F and have the net effect:



Intermediate reactions include:



Combining the above equations provides a more complete representation,



where  $x = 2y$  and the coefficients  $a$ ,  $b$ ,  $c$ , and  $d$  are variable with time, temperature, pressure, and initial concentrations of the reactants.

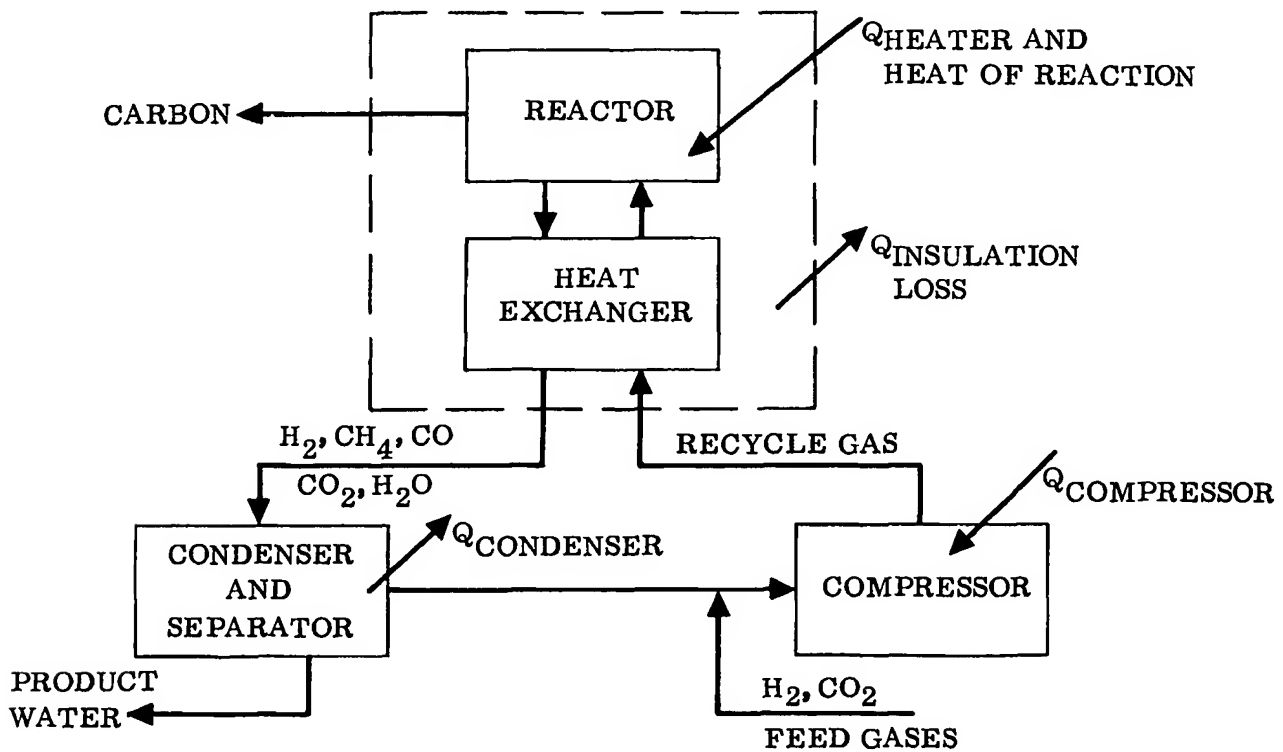


Figure 4.1 - Bosch Process Flow Diagram



N. A. Boldyreva, V. Ya. Zabuga,  
G. G. Tsapyuk, and D. F. Datsenko

UDC 662.612.324

Measurements have been made on carbon oxidation kinetics at 693-923 K. There are two parallel reactions here:  $2C + O_2 = 2CO$  and  $C + O_2 = CO_2$ , with carbon dioxide formation predominating above 823 K.

Considerable significance attaches to carbon oxidation mechanisms and kinetics. The burning of carbon at high temperatures has been fully described [1-3], the reactions being



of which (1) and (2) are primary and (3) and (4) are secondary. The CO and CO<sub>2</sub> are called correspondingly primary and secondary products. The CO/CO<sub>2</sub> ratio is close to one below 1500 K but increases sharply above it, because of the considerable contribution from (4) [1].

Low-temperature oxidation measurements [4, 5] have been made by a gravimetric method with the carbon in a vessel, which showed that the interior diffusion-limited applies in the layer at 573-873 K, while external diffusion begins to have an effect above 723 K. A kinetic equation has been proposed [5], which includes the effects from diffusion, but the gravimetric method provided only the rate constant for the overall process without allowance for the detailed mechanism.

Interest attaches to the oxidation below 1000 K when there is no diffusion complication and to discussing (1)-(4) in the formation of CO and CO<sub>2</sub>.

A quartz microreactor was used [6], with zero gradients in temperature and gaseous-product concentrations attained by means of a reciprocating glass piston that passed the gas mixture through the layer. The carbon specimen (SG-100 carbon black) had a grain size less than 250 μm and was placed in the reactor on a silica grid (specimen 0.4 g). Excess oxygen was used in a mixture of oxygen with helium (20 vol.% O<sub>2</sub>), flow rate 0.1 liter/min. The temperature in the layer was measured with a chromel-alumel thermocouple. Before the reaction started (before the mixture was admitted), the specimen was given a standard treatment: helium was passed at 0.1 liter/min for 20 min at the working temperature.

The CO, O<sub>2</sub>, and CO<sub>2</sub> were analyzed chromatographically with a thermal-conduction detector. The kinetics were examined at 653-923 K.

Figure 1 shows the temperature dependence of the amounts of CO and CO<sub>2</sub>. The oxidation at 653-713 K produces CO/CO<sub>2</sub> = 1, but the amount of dioxide considerably exceeds the monoxide at higher temperatures, which is presumably due to (3) completing the oxidation of the CO formed in (1).

The contribution from (3) to the oxidation was examined in that temperature range from the homogeneous oxidation of carbon monoxide. Figure 2 shows the conversion of CO to CO<sub>2</sub> as a function of temperature in this reactor for a CO content in the oxygen-helium mixture (20 vol.% O<sub>2</sub>) of 4 vol.%. The reaction with oxygen occurs only at 943-993 K, which is outside the range used in examining the carbon oxidation, so (3) can be neglected there.

Kiev University. Translated from *Teoreticheskaya i Eksperimental'naya Khimiya*, Vol. 24, No. 6, pp. 757-759, November-December, 1988. Original article submitted December 30, 1986.